Center Independent Research & Development: GSFC IRAD

Cubesat Compatible Digital Back-End and Low-Noise Front-End for P-band Signals of Opportunity Remote Sensing

Completed Technology Project (2017 - 2018)

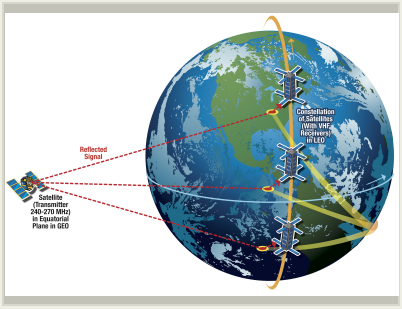
Project Introduction

The effort proposed will serve to develop a technology and science algorithm to enable measurements of root zone soil moisture (RZSM) using P-band signals of opportunity (SoOp) remote sensing from a low-cost cubesat platform. RZSM is critical for land surface hydrology and in crop forecast models.

The objectives of this project are: (1) use commercial off-the-shelf (COTS) components to develop and test a digital back-end to perform the required signal processing of narrowband incoming communication signals, (2) design, fabricate and test a miniaturized version of the low-noise front-end (LNFE) based on the signals of opportunity airborne demonstrator (SoOp-AD, IIP-13) and (3) support soil-moisture retrieval algorithm development using datasets from tower experiment at Purdue University and SoOp-AD observations.

Anticipated Benefits

Soil moisture and above-ground biomass (AGB) are identified by the World Meteorological Organization as Essential Climate Variables (ECV's). Root Zone Soil Moisture (RZSM), in particular, is critical for understanding hydrologic fluxes linking surface and subsurface processes and the interplay between the water and carbon cycles. Despite their importance, neither RZSM nor AGB are globally observed by satellites at the present time. P-band or lower (< 500 MHz) microwave observations are required for remote sensing of RZSM and AGB. From space, this necessitates a very large (>10 m) antenna, making this mission infeasible for small satellites. Radio frequency interference (RFI) is also a severe problem for radiometry in P-band or VHF. Similar problems plague active radars as well, which are further complicated by the need to acquire permission to operate within the very crowded spectrum at those frequencies. Therefore, SoOp techniques are presently the only viable path towards near-global RZSM measurements.



P-band signals of opportunity cubesat constellation concept.

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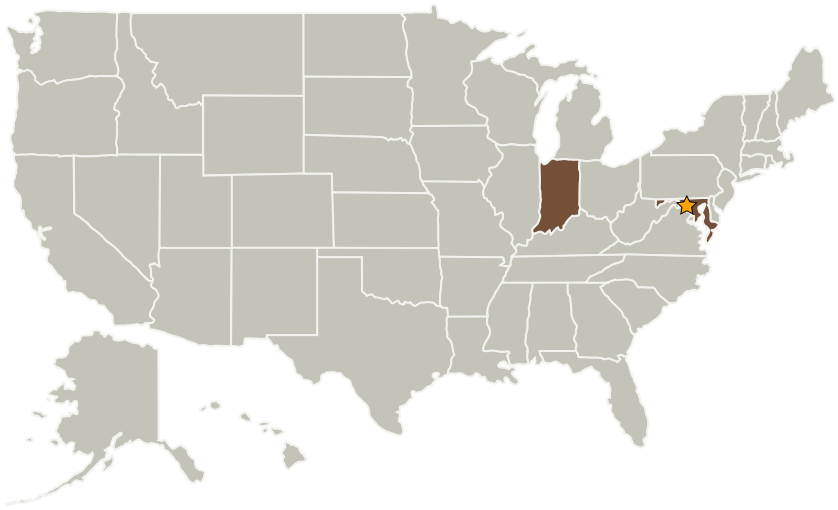
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
Purdue University-Main Campus	Supporting Organization	Academia	West Lafayette, Indiana

Primary U.S. Work Locations	
Indiana	Maryland

Organizational Responsibility

Responsible Mission Directorate:

Mission Support Directorate (MSD)

Lead Center / Facility:

Goddard Space Flight Center (GSFC)

Responsible Program:

Center Independent Research & Development: GSFC IRAD

Project Management

Program Manager:

Peter M Hughes

Project Managers:

Terry Doiron
Matt Mcgill
William E Cutlip

Principal Investigator:

Manuel Vega

Co-Investigators:

Rajat Bindlish
Alicia T Joseph
Jeffrey R Piepmeier
James Garrison

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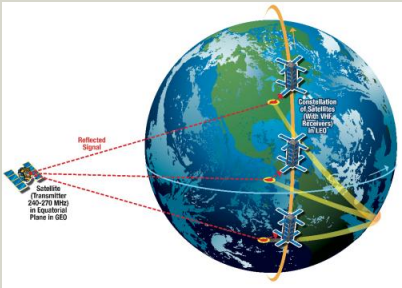
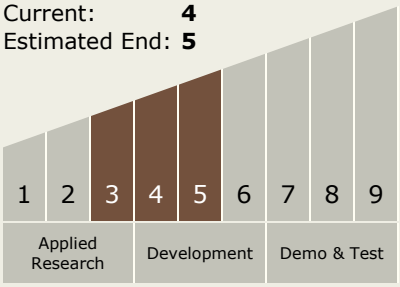
Images



P-band signals of opportunity cubesat constellation concept.
P-band signals of opportunity cubesat constellation concept. *(https://techport.nasa.gov/image/28286)*

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **5**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.1 Remote Sensing Instruments/Sensors
    - TX08.1.2 Electronics

Target Destination

Earth

Supported Mission Type

Push